Active Project (2016 - 2018)

Continued Development of Environmentally COnscious "ECO" Transport Aircraft Concepts as Hybrid Electric Distributed Propulsion Research Platforms, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

ESAero's vast TeDP and HEDP-specific experience, Helden Aerospace's distributed propulsion airframe integration effects & CFD analysis experience, and Rolls-Royce's propulsion and power, thermal management, and fault tolerant microgrid systems design experience will be leveraged to develop the ECO-150 and ECO-80 concepts as Vision Vehicles which can become research platforms to investigate the potential merits of novel technologies and stand as well-defined and reputable reference vehicle benchmarks. The ECO concepts will represent rational approaches to incorporating multiple NASA technologies in a synergistic manner for the 2030-2040 timeframe, including distributed energy management, embedded fan split-wing configuration for powered lift and improved aerodynamic efficiency and structural rigidity, ducted radiator cooling systems, hybrid power supplementation, and tail reduction via propulsive aircraft control. Complete design iterations of the ECO-150 and ECO-80 concepts will incorporate lessons learned relating to the following objectives and cross-check them with the existing vehicle design, competing discipline requirements, and detailed component integration: (1) Advance the TeDP system design through non-superconducting, high power microgrid design and detailed motor/generator sensitivity analyses; (2) Advance the TMS design with a new TMS architecture for redundancy and by applying thermal capacitance to achieve transient performance targets; (3) Take credit for the propulsion system?s utility as an aircraft control mechanism and address any new design requirements this imposes on the aircraft; (4) Investigate hybrid power supplementation and establish a roadmap for the sizing and synthesis of HEDP architectures; (5) Continue the high-fidelity aero-propulsion CFD study to improve the high lift and cruise efficiency of the split-wing design, and use the CFD results to validate and calibrate ESAero?s analytical propulsion duct models.

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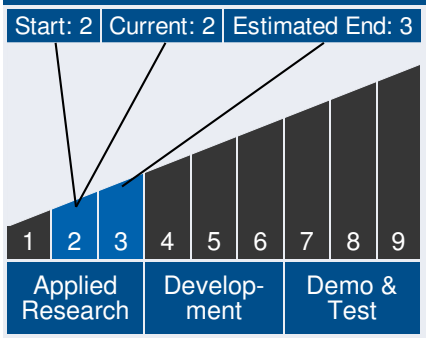
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: This work will facilitate the conceptual design of hybrid/all-electric propulsion systems from transformational thin-haul to transport air vehicles. This application comes from the improvement in fidelity and integration of TeDP and HEDP power and propulsion systems into a moderate- to high- fidelity ECO reference vehicles sized using PANTHER with power systems from Rolls Royce and aero-propulsive knowledge from Helden. This work benefits multiple NRA projects, and other direct NASA projects like RVLT, AATT and TACP. Several nuances native to the turbo-electric or hybrid electric distributed propulsion are electric component weight and structure, power transmission networks, and thermal management systems. These new design hurdles have not been addressed in previous methods or efforts, but play a significant role in determining the feasibility of these aircraft, as one of the major benefits to a decoupled energy management system using distributed propulsion is the freedom in placing the propulsors virtually anywhere. With a potential decision by NASA to determine if these types of vehicles are feasible in the next few years, the results of this ECO effort will equip NASA with opportunities for independent technology assessment and comparison, system integration and challenges, potential partnership funding paths, and potential component or system commercialization opportunities to support "vision vehicle" configurations for internal NASA studies and public relations.

To the commercial space industry:

Potential Non-NASA Commercial Applications: ESAero will use this work to guide aerospace primes toward the identification of feasible hybrid-electric architectures and support power system manufacturers interested in how their technology affects hybrid/all-electric designs. A robust PANTHER tool and high confidence vehicles will be available to advance the art and

Management Team *(cont.)*

Program Manager:
- Carlos Torrez

Principal Investigator:
- Benjamin Schiltgen

understand tradable system architecture parameters for future hybrid pursuits. Electric air vehicle design services for Aerospace companies (especially primes) are only becoming of greater demand. This has been shown by ESAero with other government entities and industry including Boeing, General Electric, Lockheed Martin, General Atomics, Electricore, automotive manufacturers, etc. While these efforts have been specific to electric- or hybrid-electric distributed propulsion type of aircraft, limitless integration opportunities to support quick iteration conceptual design with little incoming knowledge of the system provides a relatively new service and capability. There is potential and interest to sell and/or otherwise make the resultant ECO configurations and PANTHER open source to industry partners to advance the technologies necessary. Having been told that ESAero is one of the only groups looking at tube-and-wing distributed propulsion and rotorcraft at this level for more conventional machines, there is limited competition, as the major airframers and universities are looking at hybrid, blended wing bodies and larger systems.

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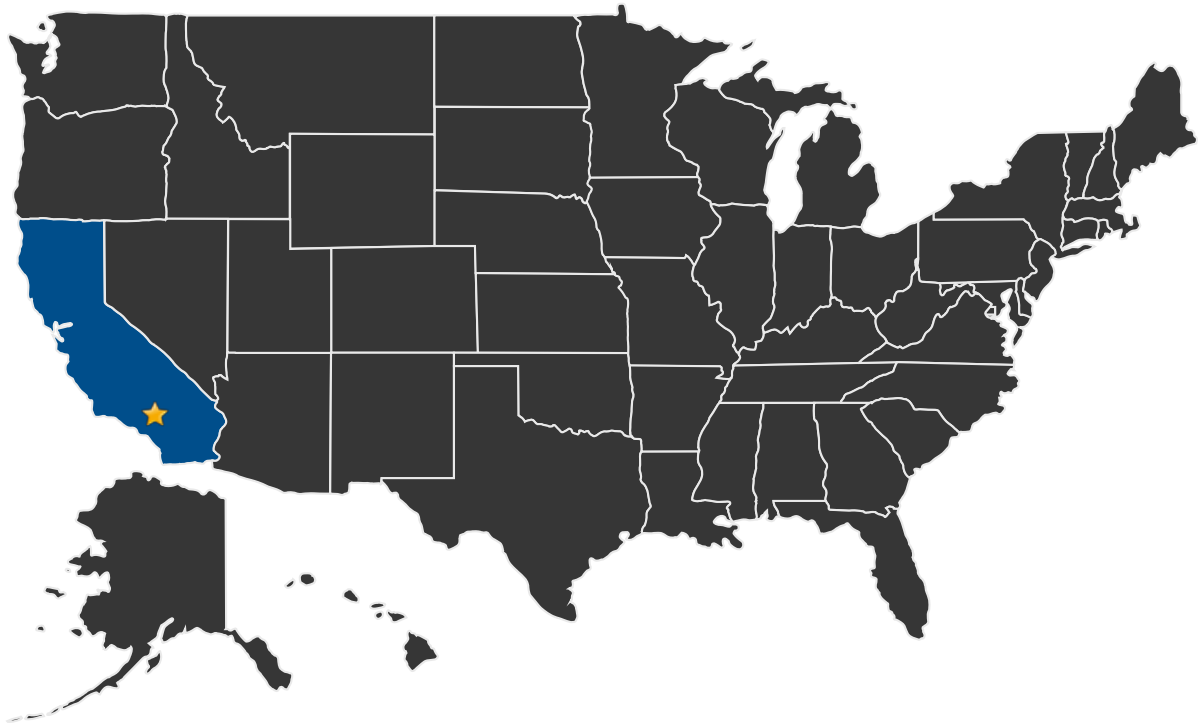
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Armstrong Flight Research Center

Other Organizations Performing Work:

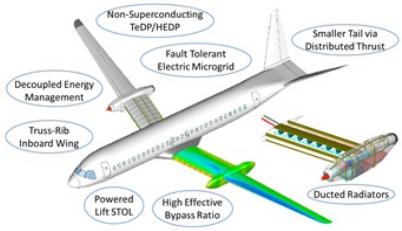
- Empirical Systems Aerospace, Inc. (Pismo Beach, CA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23352)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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